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University of Missouri

at the

Louisiana Purchase Exposition

Saint Louis, Missouri

1904

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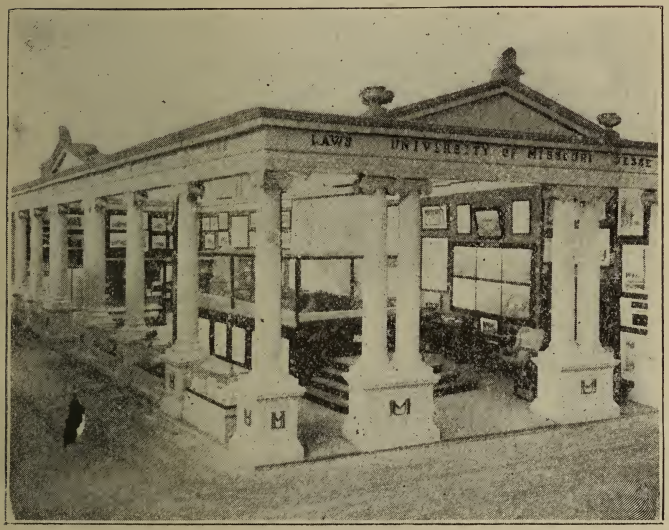
UNIVERSITY OF MISSOURI

Columbia and Rolla



UNIVERSITY EXHIBIT

at the

Louisiana Purchase Exposition

St. Louis, 1904.

THE UNIVERSITY EXHIBIT

WAS

PLANNED AND PREPARED

UNDER THE DIRECTION

OF THE

COMMITTEE ON THE UNIVERSITY EXHIBIT

AT THE

LOUISIANA PURCHASE EXPOSITION

JOHN PICKARD, CHAIRMAN

H. J. WATERS

ISIDOR LOEB

H. B. SHAW

THE EXHIBIT WAS INSTALLED AND SUPERVISED

BY

JOHN PICKARD, SUPERINTENDENT

T. K. SMITH, ASSISTANT

The University of Missouri

at the

Louisiana Purchase Exposition

MISSOURI COMMISSION.

This Exhibit is made under the direction of the Missouri Commission for the Louisiana Purchase Exposition, composed of M. T. Davis, of Springfield; L. F. Parker, St. Louis; F. J. Moss, St. Joseph; B. H. Bonfoey, Unionville; D. P. Stroup, Norborne; N. H. Gentry, Sedalia; J. O. Allison, New London; W. H. Marshall, Morehouse, and J. H. Hawthorne, Kansas City.

It is under the direct supervision of Judge J. H. Hawthorne, Chairman of the Committee of the Commission, having charge of the Educational Exhibits of the State.

THE UNIVERSITY FACULTY AT THE FAIR.

The University has contributed not only exhibits but also men for the great Exposition. The splendid Missouri Exhibits in the Palaces of Mines and Metallurgy and of Agriculture were collected, organized and arranged under the direction of Dr. George E. Ladd, Director of the School of Mines, and Prof. H. J. Waters, Dean of the College of Agriculture. Mr. L. A. Goodman, Director of the

Missouri Horticulture Exhibit, is a lecturer on Horticulture at the University.

In that comprehensive volume, "The State of Missouri," issued by the Missouri Commission among "the Missourians best qualified to discuss the various subjects therein treated" are to be found many names which appear on the roster of the University faculty. H. J. Waters, Dean of the College of Agriculture, writes on agriculture; F. B. Mumford, Professor of Animal Husbandry, upon live stock; George E. Ladd, Director of the School of Mines, upon mining; Isidor Loeb, Professor of Political Science and Public Law, upon how the commonwealth is governed; C. F. Marbut, Professor of Geology, upon geology and physiography; Jonas Viles, Instructor in History, upon history; J. S. Ankeney, Jr., Instructor in Freehand Drawing, upon art; George Lefevre, Professor of Zoology, upon the fauna; B. M. Duggar, Professor of Botany, upon the plant life of the State.

IN THE PALACE OF EDUCATION.

The main exhibit of the University of Missouri is situated in block nine in the Palace of Education, but attention is also called to important University exhibits in the Missouri sections in the Palaces of Mines and Metallurgy, Agriculture, Horticulture and Forestry, Fish and Game. Still other important matter is to be found in the United States government displays in the national government building, and in the exhibits from Agricultural Colleges and Experiment Stations in the Palace of Education.

THE JEFFERSON MONUMENT.

The central point of the University space in the Palace of Education is most appropriately filled by the original shaft erected over the great patriot's grave in 1836. Made in accordance with Jefferson's own specifications, with the marble slab containing the world-famous epitaph, these two "most precious pieces of stone on the American Continent" are reckoned among the most notable possessions of the University.

Since the Louisiana Purchase will ever rank as one of the greatest achievements of the author of the Declaration of Independence, since Jefferson was also father of the State University in America it is fitting that his monument should be in possession of the State University of the most important State carved from the Louisiana Purchase. It is needless to say that with visitors at the Exposition the Jefferson Monument vies in interest with the Liberty Bell.

The University Exhibit may be divided into two portions:

1. The general exhibit, which shows what the University is.
2. The departmental exhibits which show in part what the University is doing.

I. GENERAL EXHIBIT.

Model of the Campus of the University.

Made by George Carroll Curtis, Geographical Sculptor, Boston.

The topographical model of the grounds and buildings of the Campus is made on the scale of 1:100 which approximates the common architectural 1-8 scale. This permits the main Academic building to be some three feet long while the dome stands about 1 1-2 feet from the ground. The human figure appears nearly an inch in elevation on this scale. (The figure by steps of Academic Hall.) The scale permits great accuracy in architectural modeling, even to the pattern of cornices. Roads, walks, and paths, are accurately modeled according to the most complete data obtainable. The trees are exactly located, the general varieties as elm, evergreen and maple being distinguished. The condition of the grounds, the well-cropped grass plots, woods and rougher portions are attempted.

It has been the endeavor both to make the model correct as to the dimensions, to have it convey the appearance of the campus in early fall and also to give the most interesting portions of the place their due importance.

The methods employed in representing grass and running water are somewhat novel.

It is placed in such an elevated position that the usual view of a few feet from the ground is first presented. By ascending the steps views which range from 100 to 300 feet or more above the ground may be obtained. Good views may also be had from different positions and elevations around the entire model. Those beside that from the north end (the front) of the Campus most recommended are (1) from a point overlooking the Campus from behind the Geological Building looking northwest and (2) from the northwest

corner looking noutheast toward the Columns from as high up as is practicable.

By looking at the work through the hollow of the hand or through a paper tube, thereby shutting out extraneous objects, better scale and more effective views may be had. More natural effects may be obtained by viewing from some distance, 25 feet or more, also by low views beneath the trees.

A topographical model should convey the characteristic appearance of a place as well as the accurate rendering of the component parts.

Other Models.—In a separate case are shown models of some of the University buildings that are not located on the Campus. 1. Read Hall. 2 Horticultural Building. 3. Dairy Building. 4. Live Stock Building.

BIRD'S-EYE VIEWS.

Made by F. Humphrey Woolrych, St. Louis.

In order to show the changes which have taken place in the buildings and grounds a series of water-color views have been placed on the walls of the exhibit space, showing six important epochs in the University's history. The first picture shows the University at the completion of the first building in 1843. The second view brings us to 1873, and we find as new buildings on the Campus, the Observatory, the Agricultural Building and the first student boarding houses. The next changes of importance come in 1885 with the addition of two large wings to the old University building. The darkest hour of the University is shown in the next picture, where are seen the smoking ruins of

the great fire of 1892, in which the great main building was destroyed. How splendidly the University has risen from the ashes of that fire is shown by the pictures of the years 1895 and 1904. It required forty years for the University to reach in 1885 the culminating point before the fire. In the twelve years since the fire a new and far greater institution has grown up.

GROWTH OF THE UNIVERSITY.

With these pictures showing changes in buildings and grounds should be compared a series of charts showing a growth equally remarkable in the number of students and faculty and in the value of equipment, endowment and income. For example, in 1842 there were five teachers and fifty-nine students; in 1892, forty-nine teachers and five hundred and fifty students; in 1904, one hundred and twenty teachers and sixteen hundred and forty-six students.

PHOTOGRAPHS.

Hundreds of photographs are arranged in albums showing views in and about the University, and a series of splendid pictures adorn the walls of the space and do their part in showing what the University actually is.

II. DEPARTMENTAL EXHIBITS.

It is of importance to know what the University is. It is of greater importance to know what the

University is doing. For this knowledge we turn to the Departmental Exhibits. Though the University occupies more space than is given to any other University at the Exposition, space is lacking to show all the departments of the University or to show adequately even the departments that are represented.

AGRICULTURE.

University Exhibit, Palace of Education.

Prof. H. J. Waters; Prof. F. B. Mumford.

Cattle Feeding Experiments.—The exhibit is divided into four sections:

Section I.—Illustrating the results of feeding corn and linseed meal.

Section II.—Corn and cottonseed meal.

Section III.—Corn and gluten feed.

Section IV.—Corn exclusively.

The above rations were all fed cattle while grazing on blue grass pastures.

Photographs.—An album containing one hundred photographs illustrates the instruction and research work of the Departments of Agronomy, Animal Husbandry and Dairying.

In the Government Exhibit of Agricultural Colleges and Experiment Stations.

Department of Animal Husbandry.—Models of a warm barn, a shed opening to the south, and an open lot without protection of any kind, together with models of cattle. These are intended to illustrate the results of a three years' experiment

on the relation of shelter to the economy of beef production.

The work of the Laboratory for Animal Breeding is illustrated in the Animal Husbandry section by four mounted lambs, which are intended to show the relation of birthweight to subsequent growth, and by four mounted rabbits, four mounted Guinea pigs, and two mounted white rats. These latter specimens are shown primarily to indicate the kind of animals used for research work and the methods and principles of animal breeding. Here are also shown twenty-five enlarged photographs illustrating the Animal Husbandry work.

In the Missouri Exhibit, Palace of Agriculture.

The College Farm has furnished fifty varieties of corn and one hundred varieties of wheat, and more than one thousand specimens of economic grasses and forage plants. Diagrams graphically illustrating the component parts of the common feeding stuffs, illustrations of the results of feeding corn with various supplementary foods to cattle, and ten enlarged photographs of important laboratories, experiments, and instructional work have been prepared and placed in this exhibit.

More than fifty samples of wool were also prepared by the students of the College of Agriculture for exhibition here.

ANATOMY AND HISTOLOGY.

University Exhibit, Palace of Education.

Prof. C. M. Jackson.

This exhibit consists of three distinct parts. 1. The work in Topographic Anatomy. 2. Student

drawings in Osteology and Histology. 3. A collection of human embryos.

Topographic Anatomy.—The study of Anatomy by means of cross-sections was first introduced by Dr. C. M. Jackson, of the University of Missouri, in 1901. It has since been adopted by several medical schools. Medical students spend three afternoons a week, in the second semester of their Sophomore year, on this work. Only those who have made a complete dissection of the human body are admitted. Each student studies and makes careful drawings of serial sections of the head, trunk, and extremities. Two sets of sections are shown:

A. Sections of Head. This subject was hardened and preserved by intravascular injection of formalin. The head was then decalcified by dilute hydrochloric acid. Coronal sections were then cut with a sharp knife. The sections are shown in series from front to back; anterior view. On the right of each case is a drawing made by a medical student.

B. Sections of Trunk. The sections were prepared in the same way as the head sections, but were not decalcified. They extend, as will be noticed, from the upper part of the lung, well down into the liver. Each is about 2 1-2 cm. thick. They show especially well the relation of the thoracic viscera to each other and to the thoracic wall. It is believed that this method of study gives the student a mental picture of the body which can not be acquired in any other way.

Student Drawings.—A. Histology. These drawings were selected from the laboratory books of the first year medical class. Each student is re-

quired to make a careful drawing, in India ink, of each section studied.

B. Osteology. A complete skeleton is issued to every two students. During the course, each student draws one or more views of each bone and hands them in to the instructor for criticism. The B N A system of nomenclature is used.

Human Embryos.—This exhibit embraces a collection of human embryos from about the twenty-third day to the fifth month of intrauterine development. One series has been treated with a caustic potash mixture to show the skeleton. The accompanying card gives the length and age of the embryo. The condition of the skeleton at the various stages of development is very clearly shown. The second series is simply preserved in alcohol. They are numbered in the order of their age. Some have the foetal membranes still attached. The younger specimens are of especial interest.

ASTRONOMY.

University Exhibit, Palace of Education.

Prof. F. H. Seares.

This exhibit is in two parts:

I. Charts in wing frames showing computations by students.

1. Observations made and reduced by Junior class, School of Civil Engineering.

2. Determinations by students of latitude with the sextant.

3. Determinations by students of time with the sextant and transit.

II. Photographs of the Laws' Observatory and some of the instruments are shown in an album of University views.

BOTANY.

Prof. B. M. Duggar.

This department is represented at the Louisiana Purchase Exposition by exhibits installed in four sections as follows:

University Exhibit, Palace of Education.

Certain mushrooms, collected at Columbia, Missouri, during one season. This consists of from seventy-five to one hundred specimens (of fleshy fungi, for the most part) from a collection of about four hundred species.

They represent four orders of Discomycetes, four orders of Pyrenomycetes, six orders of Hymenomycetes, two orders of Gasteromycetes.

Some of these fungi are preserved in liquids. Dried laboratory cultures (pure cultures of the mycelium) for physiological work, have been made from about one-third of the species exhibited, and a few of these cultures are included.

Photographs.—In addition, more than one hundred photographs are shown in an album, illustrative of these fungi and of their habitats, as well as of other fungi which could not be placed upon exhibition.

In United States Government Building.

In co-operation with the Bureau of Plant Industry, United States Department of Agriculture.

The Mushroom Industry.—The Mushroom Case, illustrative of the work in mushroom growing undertaken for the Bureau of Plant Industry, has been designed with the view of giving a general exposition of the mushroom industry, and of the scientific work which is being done nationally to stimulate the industry.

Three shelves are devoted to various phases of the scientific work. It has been shown by Prof. Duggar that the tissue culture method of obtaining pure cultures is applicable to nearly all fleshy fungi whether they grow upon the earth or upon decayed wood. Cultures made by this method have been secured of many species of edible mushrooms, some of which cultures are shown in large test tubes. These are supplemented by photographs and utensils indicating the methods involved. Special mention should be made of cultures of the morel, Morchella esculenta, a fungus which rivals the truffle in flavor. In addition there are photographs and preserved specimens of edible mushrooms.

Three shelves are devoted to commercial spawns, edible products (which, at present, are largely foreign), and views of the mushroom industry. Among the spawns are to be found the English, the French, and the American, made from pure cultures. The mushroom products include nearly all species and grades of preserved mushooms which are to be found on the market, the most highly prized being the morel and the truffle.

The lower portion of the case shows types of mushroom beds employed in the growth of Agancies campestris. The habit of the mushroom is

shown by means of plaster casts, each of these being a reproduction of a mushroom or of a cluster of mushrooms grown in the experimental beds at the University.

United States Government Building.

The "Plant Laboratory" of the Agricultural Experiment Stations.

Some Plant Diseases.—This is a collection of about thirty plant diseases, most of which are so preserved as to show the characteristics of the disease, and the actual color of the green host plants. A few timber disease-organisms are also included, as well as some cultures of fungi, and apparatus showing culture media.

Palace of Education.

The Botanic exhibit of the State Agricultural Experiment Stations includes a collection of about one hundred photographs of fungi, some of which are disease-producing, timber-destroying, edible, innocuous and poisonous.

CHEMISTRY.

University Exhibit, Palace of Education.

Prof. W. G. Brown.

Analysis (Hygienic and Industrial) of public water of incorporated Missouri towns. While no absolute standard for the Chemical purity of drinking water can be given, the following conclusions may be regarded as approximately correct:

(1) The total residue should not exceed 500 parts per million.
(2) The inorganic residue may constitute the total residue.
(3) The smaller the amount of organic residue the better the water.
(4) The amount of sodium chloride should not exceed ten parts per million. A larger amount may be expected, however, in certain salt-producing districts.
(5) The organic matter in one million parts of the water should not reduce more than 8 parts of potassium permanganate.
(6) The amount of free ammonia should not exceed 0.05 part per million.
(7) The amount of albuminoid ammonia should not exceed 0.15 part per million.
(8) The amount of nitric acid should not exceed 0.5 part per million.
(9) The best waters contain no nitrous acid, and any water which contains this substance in quantity sufficient to be estimated should not be regarded as a safe drinking water.

Note.—The word "trace" whenever used indicates the existence of the substance in quantity sufficient to be recognized by the test, but too small to be determined quantitatively.

Samples of the various specimens of water examined are on exhibition.

HYGIENIC ANALYSIS

Town	Source of Supply	Color	Odor	Total residue after Evaporation	Chlorine	Oxygen Consumed	Free Ammonia	Albuminoid Ammonia	Nitrates calculated as N (Nitrogen)	Nitrites calculated as N (Nitrogen)	Number of Bacteria in 1 cubic centimetre (¼ teaspoon) water agar plts c'nt'd 3d d'y	Growth of Bacteria in beef tea at 40°-42° C.	Effects on Guinea Pig of intraperitoneal injection of beef tea culture incubated at 40° C for 24 hours	Name of Toxicogenic or pathogenic bacteria found in hearts blood of dead Guinea pig	Remarks
1 Aurorn.	Spring	Very clear	None	190	3.0	6.04	0.10	0.15	0.28	0.0	67600	Cloudy	No bad eff't		
b Aurora	Reservoir	Very elear	None	190	3.45	1.52	0.04	0.10	1.61	0.004	189005	Cloudy.	No bad eff't		Germs are high result of delay by Exp. Co. Sample delayed
c Aurora	Hydrant	Very clear.	None	102	3.45	1.74	0.032	0.03	1.60	Trace	03245	Growth	No bad eff't		
d Aurora	Spring River	Clear	None	80	3.0	0.76	0.08	0.15	1.25	0.006	3740	Growth	No had eff't		
2 Bethany	Creek	Milky cloudiness.	None	023	5.5	12.85	0.14	0.55	2.5	0.052	23582	gr'th, putrid od	Killed G. pig 6 hrs.	Bacillus Coli	
3 Boonville	Missouri River	Slightly turbid	None	383	23.05	6.8	0.032	0.16	0.40	0.008	3500	......			
4 BowlingGreen	Deep Well	Clear	None	572	49.2	2.0	0.08	0.16	12.0	Trace	220	No visible g'th.	No bad eff't		
5 Brookfield	Deep Wells	Clear	None	416	17.0	3.2	0.12	0.22	0.50	0.018	1060		No bad eff't		
6 Butler	Miami Creek	......	None	275	8.5	5.2	0.25	0.16	0.00	0.0	1040	H'vy g'th on sf.	No bad eff't		
7 Brunswick	Grand River	Very turbid	None	527	0.0	8.65	0.32	0.60	0.60	0.026	19500	......	No bad eff't		
8 C. Girardeau	Mississippi River	......	None	311	10.05	0.1	0.496	0.50	0.90	0.0383	0300	Heavy clouds, slight pellicle bad odor	No bad eff't		
9 Carrollton	......	Slight amber col. brownish precipitate	None	450	14.0	7.95	0.24	0.18	0.35	0.05	14706	Growth	No bad eff't		
10 Carthage	Spring River	Clear	None	178	4.0	2.9	0.048	0.17	0.025	0.007	660	Surface scum	No bad eff't		
11 Chillicothe	Grand River and 24 deep wells	Slightly turbid, slight yel'w tint	None	133	5.0	7.9	0.21	0.33	0.26	0.055	5859	Heavy growth.	No bad eff't		
12 Clinton	Bored wells	Clear	None	1588	075.3	3.1	0.28	0.05	0.8	0.02	105	H'dly any g'th.	No bad eff't		
b Clinton	Bored wells, hydrant in town	Clear	None	1942	800.0	0.75	0.715	0.075	Trace	Trace	8680	Heavy growth.	KilledG pig in 12 hrs.	Bacillus Coli	Reservoir ordered cleaned
c Clinton	One of deep wells	Clear	Odor of hydrogen sul.	2026	1420.0	7.00	0.746	0.075	......	0.0	30	......	No bad eff't		
d Clinton	Reservoir	Clear	......	730	......	......	......	......	......	......	510	......	No bad eff't		
e Clinton	Hydrant	Clear	None	770	......	......	......	......		......	1160	......	G. pig died		
13 Columbia	More's Lake	Clear	None	102	4.0	3.4	0.048	0.246	0.25	0.0	210	Growth	No bad eff't		
b Columbia	Hinkson Creek	Turbid	None	556	7.5	13.4	0.26	0.052	0.75	0.109	17360	Growth	KilledG.p'g	Proteus Vulgaris	
c Columbia	Hinkson Creek after aeration	Turbid	None	410	7.5	13.4	0.186	0.82	0.8	0.035	9176	Growth	No bad eff't	Unclassified	
d Columbia	Deep well, State University	Clear	None	405	10.0	1.8	0.26	0.02	0.06	0.0	80	Growth	No bad eff't		
e Columbia	Deep well, ice plant	Clear	None	472	10.0	1.1	0.524	0.048	0.29	0.0	9	No visible g'th.	No bad e'fft		
14 Fulton	Deep wells	Clear	None	520	11.0	1.3	0.009	0.03	0.25	0.0	2622	Growth	No bad e'fft		
b Fulton	Deep wells	Clear	None	531	12.5	1.75	.48	0.06	0.11	Trace	1960	Growth	No bad e'fft		
15 Glasgow	Missouri R., hyd. in Price's Hotel	Extremely turbid heavy mud sediment	None	218	10.7	14.0	0.24	0.55	0.31	0.0	118815	Cloudy growth.	KilledG.pig bet. 50 to 60 hours	Unclassified	
16 Hannibal	Mississippi River	......	Nooe	241	4.5	11.1									
17 Higginsville	Deep and dug wells, hydrant Arcade Hotel	Very clear	None	362	23.0	2.0	0.40 9.03	0.50 0.02	0.56 Trace	Trace 0.004	23750 70	Light scum on surface No visible g'th.	No bad eff't No bad eff't		
18 Holden	......	Very turbid	None	461	3.5	13.9	0.064	1.00	0.6	0.02	56300	Heavy cloud	Killed G. P	Bacillus of the colon group and motile micrococcus	
19 Jefferson City	Missouri River, hy. Madison H.	Very turbid	None	370	14.5	8.0	0.008	0.50	0.56	0.008	81250	......	No bad eff't		
20 Joplin	Shoal Creek	Clear	None	151	4.0	1.0	0.48	0.12	1.00	0.0	2980	Cloudy, slight scum	No badeff't		
b Joplin	Shoal Creek	Clear	None	159	3.0	1.35	0.02	0.12	2.50	0.0	2772	......	No bad eff't		
21 Kansas City	Missouri River	Clear	None	336	16.5	4.85	0.024	0.15	0.30	0.006	1500	Heavy cloud... No bad odor	No bad eff't		
b Kansas City	Spring No. 1	Clear	None	732	44.0	2.2	0.069	0.23	11.0	0.9	3720	Cloudy	No bad eff't		
c Kansas City	Union Springs	Clear	None	757	37.8	0.4	0.024	0.09	0.20	Trace	803	Cloudy	Killed G.P.	Germ belongs to Friedlander Bacillus group	
22 Kirksville	Chariton River	Clear	None	188	4.0	7.0	0.12	0.50	0.31	0.0	2290	Growth	No bad eff't		
23 Lamar	......	Slight amber tint	None	159	8.0	7.5	0.024	0.40	Trace	0.0	49660	Scum on surfac.	No bad eff't		
24 Lexington	Missouri River	Slight turbidity	Nooe	391	23.0	7.05	0.157	0.30	0.31	0.016	26130	Heavy cloud, putrid odor	No bad eff't		
25 Louisiana	Mississippi River hy. Planters H.	Very turbid	Slight mud odor	243	5.6	11.8	0.296	0.70	0.55	0.0	10250	Heavy cloud	Killed G.P. in 13 h.	Bacterium acidoformans	filter working poorly
b Louisiana	Mississippi River H. School hy.	Clear	None	168	8.3	5.5	0.32	0.25	0.50	0.004	121		No bad eff't		filter good-few germs
26 Macon	......	Quite turbid	......	251	3.0	12.0	0.32	0.92	0.43	0.04	23125	Heavy growth. putrid odor	No bad eff't		
27 Marshall	Three deep wells hy. Hotel Ming	Very clear	None	1202	464.0	1.95	0.432	0.13	Trace	Trace	80	No visible gwth	No bad eff't		
28 Maryville	River water	Clear	None	164	4.0	6.8	0.56	0.28	0.075	0.0	520	Scum on surf'ce	No bad eff't		
b Maryville	Water Jug No. 1.	Clear but sedim't	None	198	1.0	13.0	1.15	1.23	0.05	0.0	4267	Cloudy	No bad eff't		
c Maryville	Water Jug No. 2.	Amorph's brownish sediment	None	191	3.0	9.1	0.31	0.28	0.10	Trace	32273	Cloudy	Kill'p 2 da.	Belongs to typhoid gr'p but is not typhoid bacillus.	
d Maryville	One Hundred R.		None	216	3.0	8.22	0.93	1.045	0.05	0.125	29260	Cloudy	Killed G. pig 12 hrs.	A motile and a oon-motile bacillus not previously classified.	
e Maryville	One Hundred R.	Slightly cloudy	Vegetable odor.	200	12.0	5.85	0.42	0.58	0.75	0.013	18900	Cloudy S. on surface	Killed G. pig 12 hrs.	Motile and non-motile bacillus unclassified	
29 Mexico	Surface Reservoir Hydrant Ringo H	Amber tint	Mushroom	174	2.7	6.2	0.32	1.0	0.23	0.0	250	Scum, putrid od	p died 8th d	Bacil' coli.	
30 Monett	Dug Well	Clear	None	237	8.5	1.1	0.096	0.10	3.9	0.0	450	Heavy scum	No bad eff't		
31 Moberly	Reservoir	Slight turbidity	Slight odor	215	3.5	10.1	0.20	0.50	0.31	0.016	31200	He'vy scum, od.	No bad eff't		
62 Nevada	Bored wells	Very clear	None	1319	576.0	3.2	0.36	0.05	0.40	Trace	6618	Very faint gwth	No bad eff't		
33 Palmyra	Spring	Clear	None	420	31.5	2.9	0.056	0.07	16.65	0.0	4130	Scum on surf'ce	Died 48 hrs	Bacterium aerogenes.	
34 Paris	River	Cloudy	None	259	5.0	9.0	0.32	0.40	0.60	0.002	1500	Slight cloud	No bad eff't		
35 Poplar Bluff	Black R.	Clear	None	125	1.0	3.5	0.024	0.096	0.21	Trace	2890	Cloudy	Died 12 hrs	Related to typh' gr'p.	
36 Rich Hill	R. Marias des C.	Very turbid	None	337	13.5	8.2	0.12	0.40	0.446	0.018	11050	Heavy gwth od.	Died few da		
37 St. Charles	Missouri R.	Slight cloudiness	None	423	25.1	4.8	0.20	0.17	0.46	0.040	1995	Scum on surf'ce	No bad eff't		
38 St. Louis	Mississippi R	Milky cloudiness	None	381	22.5	5.9	0.32	0.30	1.04	0.08	14694	Scum on surf'ce	No bad eff't		
69 Sedalia	Deep Well test before completion	Clear	None	318	4.0	0.15	0.03	0.075	0.125	Trace	7361	......	G. pig died	Bacil' coli.	Jug not properly prepared, hence bacillus coli means nothing.
b Sedalia	Deep Wells and Reservoir mixed	Slightly turbid	None	134	4.0	3.5	0.12	0.25	0.12	0.0	320	Scum on surf'ce	No bad eff't		
40 Slater	Deep Well Hotel Hydrant	Very clear	None	726	165.0	3.1	0.48	0.09	0.46	0.009	146	No visible gwth	No bad eff't		
41 Springfield	Spring	Very clear	None	229	4.5	1.8	0.04	0.12	3.9	Trace	14012	Heavy scum	No bad eff't		
42 Trenton	Grand River		None	202	4.0	10.3	0.80	0.60	0.32	0.0714	19530	Cloudy, scum	No bad eff't		
43 Warrensburg	Artificial Lakes State Normal Hydrant	Clear	None	158	6.1	3.4	0.08	0.30	0.237	0.0	360	Slight gwth	No bad eff't		
44 Washington	Missouri R.	Fairly clear	None	357	17.0	8.9	0.20	0.40	0.875	0.0	3800	H'vy c'ld, scum	No bad eff't		
45 Webb City	Spring and Creek	Clear	None	412	5.0	1.15	0.096	0.22	1.56	0.0	120	Slight cloudiness, no odor	No bad eff't		
For comparison: N. Y. City	Surface Water			75	2.8		0.000	0.06	0.28	0.0					
Brooklyn	Sub-soil Water			54	13.5		0.001	0.07	15.00	0.0					
Boston	Surface Water			47.6	5.1		0.008	0.16	0.07	0.001					
Cincinnati	Surface Water			140	14.0		0.003	0.09	0.26	0.01					
Chicago	Surface Water			136	2.3		0.005	0.075	Trace						
Philadelphia	Surface Water			120	4.0		0.01	0.10	1.0	0.0					
Wash'n D. C.	Surface Water			126	2.8		0.00	0.12	1.0	0.001					

INDUSTRIAL ANALYSIS

Locality	Total Solids: Grains per U.S. Gallon	Total Solids: Parts per Million	Loss on Ignition: Grains per U.S. Gallon	Loss on Ignition: Parts per Million	Silica (SiO_2): Insol. in HCl. Grains per U.S. Gallon	Silica (SiO_2): Parts per Million	Alumina (Al_2O_3): Grains per U.S. Gallon	Alumina (Al_2O_3): Parts per Million	Ferrous Oxide (FeO): Grains per U.S. Gallon	Ferrous Oxide (FeO): Parts per Million	Lime (CaO): Grains per U.S. Gallon	Lime (CaO): Parts per Million	Magnesia (MgO): Grains per U.S. Gallon	Magnesia (MgO): Parts per Million	Sulphur Trioxide (SO_3): Grains per U.S. Gallon	Sulphur Trioxide (SO_3): Parts per Million	Chlorine: Grains per U.S. Gallon	Chlorine: Parts per Million
Aurora	9.8946	169.4	0.4789	8.2	0.4789	8.2	0.0088	0.15	0.0643	1.1	4.4508	76.2	0.2371	4.06	1.2499	21.39	2.0151	3.45
Bethany	17.5250	299.6	1.6936	29.2	10.4186	178.4	0.1226	2.10	0.0993	1.7	3.7609	64.4	1.0069	16.92	3.0625	52.4	0.3212	5.5
Booneville	22.3943	383.4	1.4368	24.6	4.5093	77.2	0.3715	6.36	0.4381	7.5	4.6844	80.2	1.4924	25.55	3.8551	66.25	1.9567	33.50
Bowling Green	33.3251	572.2	9.5266	163.1	0.2336	4.0	0.0403	0.69	0.1226	2.1	9.2988	159.2	3.4403	58.89	2.3189	39.71	2.8737	49.20
Brookfield	24.3277	416.5	1.1156	19.1	1.0046	17.2	0.0169	0.29	0.1460	2.5	5.2861	90.5	1.1367	23.40	2.8504	48.83	0.9029	17.00
Brunswick	30.8054	527.4	1.8107	31.0	15.7765	270.1	0.8469	14.5	1.4250	24.4	3.3995	58.2	0.9311	15.94	1.9861	34.22	0.3504	6.00
Butler	16.0744	275.2	1.2032	20.6	0.4789	8.2	0.0187	0.32	0.2044	3.5	6.1330	105.0	1.1261	19.28	3.9135	60.65	0.5549	0.50
Cape Girardeau	18.2004	311.7	1.5997	29.1	4.8714	83.4	0.2833	4.85	0.5315	9.1	3.2476	55.6	0.7547	12.92	2.6343	45.13	0.5899	10.10
Carrollton	25.4543	437.5	1.5068	27.3	2.1608	37.0	0.0759	1.30	0.2803	4.8	8.1623	139.8	2.4090	41.25	2.6757	45.8	0.8526	14.6
Carthage	10.3736	177.6	0.6834	11.7	0.9404	16.1	0.0157	0.20	0.1811	3.1	4.0887	70.0	0.4106	7.03	1.2207	20.85	0.2453	4.20
Chillicothe	10.7007	183.2	0.9696	16.6	1.1916	20.4	0.0157	0.27	0.4614	7.9	0.2962	5.1	0.6542	11.23	1.2441	21.26	0.2921	5.00
Clinton	92.7403	1587.8	7.9496	136.1	0.4906	8.4	0.0123	0.21	0.1811	3.1	9.1003	155.8	4.8713	83.40	5.4906	94.03	30.0471	668.50
Columbia (a) City Supply	16.4132	281.0	1.4777	25.3	0.8002	13.7	0.0624	1.24	0.3096	5.3	4.8480	83.0	0.8276	14.17	5.3787	91.97	0.3563	6.10
Columbia (b) Deep Well U. of M.	22.9658	693.2	1.1682	20.0	0.6251	10.7	0.0058	0.10	0.1285	2.2	4.8597	83.2	2.7581	47.22	3.2242	55.20	1.1332	19.40
Fulton	60.1454	516.1	3.2624	56.2	0.4438	7.6	0.0403	0.69	0.1518	2.61	7.1598	122.6	3.7124	63.57	6.3650	109.1	0.7651	13.1
Glasgow	12.71	218.0	3.6389	62.3	2.2004	38.7	0.7346	12.68	0.6425	1.0	1.9865	34.1	0.7301	12.46	1.4836	25.37	0.6249	10.70
Hannibal	14.0534	240.6	1.8632	31.9	3.2476	55.5	0.1863	1.48	0.5958	10.2	2.6051	44.6	0.9591	16.42	1.8399	81.55	0.2458	4.20
Higginsville	21.1473	362.1	1.3901	23.8	1.0514	18.0	0.0169	0.29	0.1588	2.6	4.1705	71.4	0.7832	13.41	1.2850	22.02	1.3142	22.50
Holden	26.0211	460.9	2.1612	37.0	14.7060	252.8	1.7453	29.88	1.7465	29.9	1.4953	25.0	0.7943	13.64	1.7581	30.11	0.2044	3.50
Jefferson City	21.6233	370.2	1.6872	28.8	5.8760	100.0	0.7640	13.08	0.6717	11.5	3.7966	65.0	1.1448	19.64	3.1541	53.01	0.8469	14.50
Joplin	8.7907	150.5	3.9135	67.0	0.3446	5.9	0.0105	0.18	0.1285	2.2	3.8434	63.8	0.3093	5.29	0.9589	10.37	0.2219	3.80
Kansas City	19.5491	336.4	1.1798	20.2	1.0455	17.9	0.0473	0.81	0.1810	3.1	6.4601	110.6	1.5361	26.81	4.5559	78.49	0.9636	16.50
Kirksville	10.1751	174.2	1.0105	17.3	0.6191	10.5	0.0070	0.12	0.1986	3.4	2.7688	47.4	0.7826	13.41	1.6939	29.63	0.2513	4.25
Lamar	9.2872	159.0	0.8878	15.2	3.6214	62.0	0.0023	0.04	0.2278	3.9	2.5807	44.2	0.4743	8.12	2.0444	35.12	0.4678	8.00
Lexington	25.1163	434.1	1.5768	27.8	1.0221	17.5	0.1402	2.40	0.2688	4.6	7.3000	125.0	1.6819	28.80	5.2902	91.10	1.2848	22.00
Louisiana (a) Hydrant	14.1936	248.0	2.8737	49.2	3.3176	56.8	0.4935	8.45	0.6229	10.7	1.8867	32.3	1.1039	18.93	1.9947	34.16	0.3271	5.60
Louisiana (b) Reservoir	10.1283	173.4	1.3317	22.8	0.9402	16.2	0.1192	2.04	0.2677	4.6	2.4182	41.4	1.0671	18.26	2.6559	45.26	0.5374	9.20
Macon	14.6404	250.6	2.2020	37.7	7.0040	130.2	0.4217	7.22	0.7184	12.3	1.0173	17.4	0.4439	7.61	1.1562	19.81	0.2044	8.50
Marshall	70.2088	1202.0	4.8363	82.8	0.6600	11.3	0.0958	1.64	0.2153	4.2	12.7451	218.7	2.2862	39.14	9.2988	159.17	27.1022	464.00
Maryville	9.5026	164.4	0.5899	10.1	0.3271	5.6	0.0105	0.18	0.1226	2.1	2.9731	50.9	0.9187	15.73	0.0558	16.42	0.2395	4.10
Mexico	10.1633	174.0	2.2078	37.8	6.0461	52.1	0.4468	7.65	6.8119	13.9	0.8112	15.6	0.9058	17.22	0.4966	8.50	0.1577	2.70
Moberly	11.0979	193.5	0.9344	16.4	8.8107	150.8	0.0157	0.27	0.0718	1.23	0.5256	9.0	0.3994	6.84	2.0411	34.90	0.2044	6.50
Monett	15.8548	287.2	1.4427	24.7	0.6133	10.5	0.0058	0.10	0.0993	1.7	5.2511	89.9	0.7218	12.36	2.4415	41.76	0.4789	8.20
Nevada	72.9132	1248.3	1.2850	22.0	0.5841	10.0	0.0105	0.18	0.1285	2.2	7.0150	120.1	3.7359	63.96	4.1938	71.85	33.6441	576.00
Palmyra	24.7015	422.9	2.0385	34.9	1.1682	20.1	0.0117	0.20	0.2804	4.8	8.7439	149.7	0.9737	16.67	3.8901	66.60	1.8399	81.50
Paris	15.1452	259.6	2.1903	37.5	2.1728	87.2	0.4182	7.16	0.4751	8.1	3.6273	62.1	0.8826	15.11	3.6389	62.28	0.3218	5.50
Rich Hill	22.0221	387.3	2.0555	50.6	4.6553	79.7	0.3633	6.22	0.5374	9.2	5.8352	99.9	1.1156	19.10	2.3949	41.12	0.7885	12.50
Sedalia	7.8345	134.8	1.2149	20.8	0.7126	12.2	0.3925	6.72	0.2044	3.5	1.6472	28.2	1.1431	19.57	3.7732	64.68	0.2394	4.10
Slater	42.4290	726.4	7.4764	128.0	0.3037	5.2	0.0058	0.10	0.1285	2.2	6.7464	115.5	2.7686	47.41	3.2418	55.54	9.6961	166.00
Springfield	13.6583	228.7	0.8586	14.7	0.8937	15.3	0.0123	0.21	0.1752	3.0	5.5472	94.8	0.4710	8.08	0.8411	14.86	0.2628	4.50
St. Charles	24.7249	423.6	1.5887	27.2	3.2126	55.0	0.3931	6.73	0.3855	6.6	5.5255	94.6	1.8440	31.56	4.1296	70.71	1.4661	25.10
St. Joseph	18.6912	319.7	0.9811	16.8	1.9564	33.5	0.0169	0.29	0.1460	2.5	3.9812	68.1	1.8181	22.57	2.5018	42.8	0.4672	8.00
St. Louis	22.2776	381.4	1.8691	32.0	4.6340	74.2	0.4334	7.42	0.5432	9.3	8.9252	67.2	1.4607	25.01	4.2381	72.07	1.3113	22.50
Trenton	11.7754	201.6	1.5478	20.5	6.2320	5.5	0.1565	2.68	0.6483	11.1	1.8223	31.2	0.5122	8.77	1.6238	27.77	0.1986	3.40
Washington	20.9523	357.0	2.1152	36.4	6.4578	50.2	0.3347	5.76	0.5665	9.7	8.7148	63.6	1.0946	18.74	0.7611	13.03	0.9520	16.30
Warrensburg	9.8421	168.5	0.9462	10.2	0.5141	8.8	0.0687	1.09	0.1811	3.1	2.9614	50.7	0.8259	14.14	1.0097	20.06	0.3563	6.10
Webb City	23.0402	412.4	1.8048	30.9	4.4391	76.0	0.0403	0.09	0.1518	2.6	7.7627	132.9	0.7073	12.11	9.8421	168.52	0.2804	4.80

CIVIL ENGINEERING.

University Exhibit, Palace of Education.

Prof. F. P. Spalding.

This exhibit comprises: (1) A series of specimens illustrating tests made by students in the Laboratory for testing materials. These comprise fineness tests for cement, and tests of strength and elasticity of wood, iron, and steel.

(2) A few drawings, showing work in Structural Design, with note books, illustrating methods employed in designing and computation.

(3) Maps showing work of Freshman and Sophomore classes in surveying.

(4) Photographs in an album, showing instruments and classes in surveying, and equipment used in testing materials.

CLASSICAL ARCHAEOLOGY.

University Exhibit, Palace of Education.

Prof. John Pickard.

This exhibit is limited to framed photographs of views in the Museum of Classical Archaeology.

ECONOMICS.

University Exhibit, Palace of Education.

Prof. J. E. Pope.

This exhibit consists of eleven maps and eight charts, accompanied by brief explanatory notes. They are designed to portray the industrial and financial history of the State of Missouri from 1764 up to the present time.

The eleven maps illustrate the spread of population, paying special attention to the influence of waterways and artificial roads upon the extension of settlement. The period after the introduction of railways receives special attention, a map having been prepared for each decade showing the construction and direction of railways during that period of time. The notes accompanying the maps present the influences leading to the economic movements, the magnitude of industry as it expanded, and the various tendencies which have appeared from time to time.

The eight charts take up in more detail some of the industrial changes that have taken place, and, they also present the most important developments in the financial history of the State. Among the subjects treated on the charts are the following:

The History of the State Debt.

The History of the Sources of Revenue in the State.

The Growth of Taxable Wealth in the State by Counties.

The Growth of Manufactures in the State.

The Growth of Agriculture in the State.

Development of Insurance in Missouri.

Development of Missouri Building and Loan Associations.

Comparison of Taxation in Missouri and in Neighboring States.

ELECTRICAL ENGINEERING.

University Exhibit, Palace of Education.

Prof. H. B. Shaw.

The exhibit consists of:

I. Apparatus made and used at the University:

1. Oil-damped magnatometer of simple form and cheap, reducing very much the time required to take observations.

2. A set of magnatometric apparatus making use of the magnatometer in the measurement of the magnetic qualities of iron wire.

3. Potential curve apparatus for determining the distribution of the potential around the commutator of a dynamo.

4. An oscillograph constructed by a student in 1900, of historical interest only. The quartz fiber used as a suspension with this oscillograph was made by a method now in use and this is believed to be the first suspension made by the method.

II. Results of Students' Work as Shown by:

1. Bound Theses.

2. A book of curves of results in the dynamo laboratory.

3. A book of designs of an electric light plant for the University.

ENTOMOLOGY.

University Exhibit, Palace of Education.

Prof. J. M. Stedman.

The exhibit comprises:

1. A box containing the more common insecticides used for the destruction of the various injurious insects, together with formulae for making the same.

2. A box illustrating Seasonal Dimorphism.

3. A box containing species representing Sexual Dimorphism.

4. Twelve boxes representing species of injurious insects that are conspicuous either on account of their size or of their beautiful coloration. Each species is represented in its complete stages of blown larva, pupa, cocoon and male and female adults.

5. Fourteen photographs in an album illustrate the Department of Entomology.

Exhibit of Agricultural Colleges and Experiment Stations—Government Exhibit, Palace of Education.

1. A new breeding cage, invented by Professor Stedman, which allows of the rearing of various leaf and fruit insects in their natural conditions and yet confines the insects so that they can not escape. The cage is divided into halves, which are placed about the trunk or stem of the plant and sunk into the ground a few inches. This is then filled with sand to the proper depth and arranged to prevent the insects from escaping between the cage and the trunk. A cheese cloth is placed over the entire plant and around the cage so that the insects are prevented from escaping to the outside. At the same time they can enter the ground, and, as the bottom of the cage is covered with wire gauze, they can not escape. Since the moisture from below can come up, the insects in the ground will be in the same condition as though the cage were not there.

2. A new root breeding cage, invented by Professor Stedman, which enables one to observe at

any time the various insects that may be upon the roots of plants without disturbing the insects or the plants. At the same time they are both under perfectly natural conditions. Screens keep the roots and the insects in the dark except when removed for observation.

3. A new form of spreading board.

GEOLOGY.

Prof. C. F. Marbut.

Relief Maps of Missouri.—Five relief maps, colored to show various features of geographic and economic interest. The horizontal scale of the maps is 1:125000, or about two miles to one inch. The vertical scale is 1:12000, or about 1,000 feet to an inch. The size of the maps is about 13 1-2 feet by 16 feet. The area covered is the whole of the State of Missouri and a strip of Illinois, Kansas and Nebraska, sufficiently wide to include the whole width of the Missouri and Mississippi bottom lands. The data on which the relief is based is gathered from all available published sources, including the maps and reports of the United States Geological Survey, the Missouri Geological Survey, the Mississippi River Commission, the Missouri River Commission, and the United States Land Office Survey, and from reconnoisance mapping by C. F. Marbut and Otto Veatch. The area based on such data as the last named is large, including all of the northern part of the State north of the latitude of Louisiana and most of the area lying south of the main line of the St. Louis and San Francisco railway. The intimate general

knowledge of this area that has been obtained by ten years of geological work in the region has enabled the author to produce a fairly good general picture of the topography of the area. The attempt has been made and it is believed, with success, to show the various characteristics of the topography with faithfulness even though it has been impossible to show details with accuracy. The various stages of dissection from even plains to the thoroughly and deeply dissected regions are clearly shown and accurately located. The width of the river and creek valleys is also shown. The elevations are more nearly correct than is the detail of the topography. This has been made possible through the railway levels, the many hundreds of barometer readings in the region and the fact that most of the rivers may be used as lines of levels on account of the fact that they are all graded.

The details even of the topography along all the railway lines of the State are about as accurate as the scale of the map will permit. Surveys were made along all the lines of the State for this purpose.

All the data from all the sources named was collected and converted into a contour map of the State on the same scale as the relief map, with a contour interval of 100 feet. A relief map in sections made of cardboard and modelling clay was made from this contour map. Gelatine negatives were cast from these sections and plaster positives cast from these negatives. These positives were trimmed, smoothed and gone over carefully and compared with the contour map. From these completed positive sections a final negative was

cast, from which the five relief maps were cast in two sections each. The final positives were further trimmed and smoothed before they were colored and lettered.

The various maps were finished as follows:

The first map was finished merely as a general political map of Missouri. It shows the cities, towns, and postoffices, the railway lines, county lines, and names of rivers and most creeks. It is installed in the model library of the Missouri Building.

The second map was colored to show the agricultural soils of the State. It shows ten different classes of soils, the classification being based partly on origin and derivation of the soil and partly on productivity. The same classification of the soils of the State is shown on a small map in "The State of Missouri," Walter Williams, editor (E. W. Stephens, publisher, Columbia, Mo.), accompanied with a description of each kind of soil and a discussion of its capabilities so far as is known at present. It is installed in the Agricultural Building.

The third map was colored to show the fruit soils of the State. Two areas or belts are shown in which fruit growing on a commercial scale is possible, and another area in which fruit growing for home use or for special local markets only, is advised.

The two fruit areas are the River Hill fruit belt, consisting of a belt extending along both sides of the Missouri river extending backward from the river some three to twenty miles and the Ozark fruit area, including practically the whole of the Ozark region. This map is colored on the au-

thority of Prof. J. C. Whitten, Professor of Horticulture in the University of Missouri, and Hon. L. A. Goodman, Secretary of the Missouri State Horticultural Society. It is installed in the Horticultural Building.

The fourth map was colored to show the geological formations of the State and the mining districts.

The rocks of the whole State are differentiated into twenty-four different formations. The greatest number of formations placed in any geological map of the State heretofore made has been less than half this number, excepting the small geological map in "The State of Missouri," on which there are twelve formations.

This is the first time that an attempt has been made to differentiate the various geological formations that occur in the Ozark regions of Missouri. As a result of this differentiation the main structural lines of the State are well brought out. It is clearly shown that the lines are axes of folding in the Ozark region run northwest and southeast instead of northeast and southwest. It shows the existence of four lines of uplift or four anticlines, in each one of which the axis has a northwest southeast trend and one pronounced syncline whose axis has the same trend. The axis of the main anticline runs through Franklin, Washington, Iron, Madison, and Wayne counties; another through Morgan, Camden, and Laclede; a third through the northwestern part of Boone, and the fourth through Lincoln, Pike, Ralls, and Marion into Knox. The pronounced syncline referred to runs through St. Louis, St. Charles and Audrain and thence northwestward.

The map shows also that the course of the Mississippi river is well adjusted to the structure, that stream flowing either parallel to or perpendicularly across the folds. This map is installed in the Mining Building.

The fifth map also was colored to show the distribution of the geological formations. It is very much the same as the fourth map. It does not show the various mining camps and is slightly more detailed in its geology. All the geological and structural features that are brought out on the fourth map are also brought out on this. It is installed in the Missouri University Exhibit in the Education Building.

The labor of making the maps has been performed wholly by students of the University of Missouri. The only part of the work that has been done by persons other than students is the painting, which was done by Mr. A. H. Glass, of Columbia. Apart from the knowledge, energy and skill of Professor C. F. Marbut it is to the keen interest that was taken by the students in this work that most of the success is due.

HISTORY.

University Exhibit, Palace of Education.

Dr. Jonas Viles.

Presidential Elections in Missouri.—The exhibit of this department consists of twenty-two maps, which illustrate the strength and the distribution of the political parties in Missouri at the presidential elections. In every election the counties car-

ried by either candidate are indicated by the color assigned to that party; but each color in turn is divided into three tints to show, in a general way, the size of the majority. For example, as yellow is used throughout to indicate the democratic majority, a democratic county where the party polled less than 60 per cent of the total vote, i. e., where the ratio between the votes of the two parties was less than three to two, is colored the lightest tint of yellow to indicate that the vote of the county was a close one. In the same manner if the ratio was less than three to one, the second tint indicates a strongly democratic county; and, when the ratio is three to one or over, the darkest tint indicates an overwhelming democratic majority. Similarly the tints of the green or blue show the counties carried by the whigs or the republicans, and the proportion of the total vote cast by the successful party.

There are no maps for the elections of 1820, 1824, and 1832. In 1820 and in 1824 the presidential electors were chosen by the legislature. A careful search at Jefferson City and at St. Louis has failed to disclose the returns for 1832. In 1860 the issues were so important and the candidates so many that it seemed best to show the strength of each in every county by colored strips proportionate in width to the vote of each candidate. Two supplementary maps show the distribution of the Breckenridge vote and the Lincoln vote, as indicating the strength of the extreme pro-slavery party and the unconditional Union party. The vote on the so-called "Drake Constitution" of 1865 is included in this series as showing the beginnings of the modern democratic and republican

parties in the State. In 1880 the vote of a third party, the "greenback," was of sufficient importance to demand a map illustrating its distribution.

As the presidential electors have always been chosen in Missouri on a general ticket, it seemed best (in order to avoid confusion) to omit the division into electoral districts. To obtain an absolutely correct idea of the relative strength of the parties in the total vote of the State, these maps, especially those of the earlier elections, should be compared with others showing the density of population. It is hoped, however, that this exhibit will give an accurate and adequate idea of the political conditions in every county and section of the State at the presidential elections.

HORTICULTURE.

University Exhibit, Palace of Education.

Prof. J. C. Whitten.

Winter Temperature of Peach Twigs.—Models showing the relation of color to the winter temperature of peach twigs, to the hardiness of fruit buds, and to their time of blossoming in spring.

Lime wash on peach twigs reflects the heat from the sun, thus holding the fruit buds at atmospheric temperature and enabling them to remain dormant on sunny days in winter and consequently resistant to subsequent cold.

The natural purple coloring matter of peach twigs which are not whitened absorb sun heat which is often sufficient to raise the temperature

of the twig fifteen degrees above the temperature of the surrounding atmosphere. This causes the fruit buds to swell and grow sufficiently on sunny winter days that they are subject to injury from subsequent cold.

Varieties of peaches possessing pale green twigs absorb less heat than do those varieties possessing purple twigs and the former are less liable to winter injury than are the latter.

Whitened peach trees blossom later in spring than do those whose purple coloring matter is left exposed to the sun, and they are, therefore, less liable to injury from late spring frosts.

Peach trees which are protected from winter sunlight by means of covering of straw (as shown in the accompanying model) are also rendered less liable to winter injury.

Winter Forcing of Asparagus.—Model showing method of forcing asparagus in the open field in winter. An artificial method of forcing asparagus in the open field in winter devised at the University of Missouri; consists of heating the soil about the plants by means of steam emitted into underground tunnels between the rows of asparagus. The asparagus field is (1) trenched between the rows and these trenches covered to form tunnels in the soil just below the crowns of the asparagus plants; (2) the field is mulched with straw to retain the heat at any time during winter; (3) steam is then blown into these tunnels through a steam hose, from the greenhouse boiler. An average of three to five minutes is required to blow in a sufficient quantity of steam to heat the rows on either side of the tunnels. This heat will easily be retained for twenty-four hours before a second

steaming is required. Daily applications of steam for ten days or two weeks are sufficient to produce the first crop of asparagus plants. If the heating is kept up daily the plants will continue to produce for about eight weeks before their energy is exhausted. If allowed to grow without cutting during the subsequent summer, the plants recover their energy sufficiently to admit of forcing during each alternate winter. This has proven to be of importance to market gardeners who heretofore have forced asparagus in winter only by removing the plants to a warm cellar or greenhouse where they were forced by artificial heat. This old method destroys the plants to such an extent that they are not suitable for future use. Forcing in the open field does not destroy the plants and saves the expense of storage and of moving the plants.

Photographs.—In an album many photographs are also shown.

Missouri Exhibit, Palace of Horticulture.

Jars of Fruit.—Here are exhibited several hundred glass jars of preserved fruits and horticultural specimens. Among the more important is a collection of over one hundred varieties of American grapes. These grapes are representative of the leading types and varieties originated from the various wild specimens of American grapes, and were grown on the Experiment Station grounds at Columbia. They give opportunity for a study and comparison of the leading types of American native grapes and their comparative adaptability to our climatic conditions.

The exhibit also embraces the leading types and varieties of plums originated from native wild

species of this country, together with types of plums introduced from other parts of the world. Varieties of peaches representing the leading varieties cultivated in this State are also included. It also shows specimens of the leading varieties of apples and pears grown in Missouri. In selecting these specimens, care has been taken to secure those which typically represent the development of each variety or type as ordinarily grown in the State.

A Pathological Collection, showing the principal diseases of cultivated fruits is also included.

Photographs.—The Department has also prepared three hundred enlargements, 16 x 28 inches each, illustrating the horticultural work of the Department as well as many large orchards, berry fields, and vineyards which typically represent the fruit-growing interests throughout the whole State. Special mention may be made of the fact that methods of handling and managing fruit trees are shown by means of photographs of specimen trees from the time of the planting of the orchard on up to bearing age. These trees are shown before and after pruning each year in order to illustrate thoroughly the method of handling under ordinary condition as well as after severe winters or whenever any unusual circumstance requires special methods of pruning.

INTERNAL MEDICINE.

University Exhibit, Palace of Education.

Prof. W. J. Calvert.

To facilitate the work of the instructor in imparting, and to assist the student in obtaining a

mental picture of the several organs of the body, a series of charts has been outlined. A portion of these are here exhibited.

The purpose of the charts is as follows:

1. To give prominence to the anatomical data most used by the clinician.
2. To represent the various organs in normal size.
3. To represent sounds, normal and pathological, by lines over their respective areas.
4. To keep the bony structures in mind as landmarks.

Four original charts, representing the outlines of the body, its organs, blood-vessels, are necessary, one each for the anterior, posterior, right and left sides.

The subject-matter of some of the charts is as follows:

Chart No. 1 represents normal area of lungs, heart, liver and kidneys.

Chart No. 5 represents mitral insufficiency with enlarged heart. The triangles show the directions of transmitted systolic murmurs.

Chart No. 6 represents aortic stenosis with transmitted murmurs.

Chart No. 7 represents aortic insufficiency with transmitted murmurs.

Chart No. 8 represents the area of relative and absolute dullness of the liver, absolute dullness of the heart and a limited pleural effusion on left side. Black lines represent dullness.

Charts Nos. 9 and 10 represent front and left side view of abdominal aneurysm.

Chart No. 11 represents normal outlines of lungs, heart, aorta, spleen, liver and kidneys.

Chart No. 12 represents an extensive pericardial effusion with areas of dullness.

LAW.

University Exhibit, Palace of Education.

Judge John D. Lawson, Dean.

Legal Publications.—The collection includes all obtainable works on law—treatises, encyclopedia or magazine articles—written by members of the Faculty of Law and graduates and students in the Law Department.

Bliss, Philemon, LL. D. (Dean Law Department, University of Missouri, 1872-1889.)
- Code Pleading.
- Sovereignty.

Fisher, Samuel B., LL. B. (University of Missouri, 1890.)
- Articles (Encyclopedia of Pleading and Practice), 3 vols.
- Articles (Cyclopedia of Law and Procedure).

Hale, William B., LL. B. (University of Missouri, 1890.)
- Bailments.
- Damages.
- Torts.
- Miscellaneous Articles (Am. and Eng. Enc. of Law).
- Miscellaneous Articles (Cyc. of Pleading and Practice), 2 vols.

Jennings, Frank, B., LL. B. (University of Missouri, 1900.)

Articles (Cyclopedia of Law and Procedure).

Kelley, Henry S., LL. D. (Professor of Law, University of Missouri, 1872-1882.)

Missouri Criminal Law and Procedure.

Missouri Justices and Constables.

Missouri Probate Guide.

Key, William C., LL. B. (University of Missouri, 1897.)

Overruled Cases.

Lawson, John D., LL. D. (Professor of Law, University of Missouri, 1891-1903, Dean of Law Department, University of Missouri, 1903—.)

Bailments, Principles of.

Contracts, Principles of.

Contracts (Cyclopedia of Law and Procedure).

Contracts of Common Carriers.

Concordance of Words and Phrases.

Criminal Defenses, 5 vols.

Digest Nevada Reports.

Expert and Opinion Evidence.

Insanity as a Defense to Crime.

Leading Cases Simplified, 3 vols.

Making of a Contract, The.

Miscellaneous Essays.

Personal Property Cases.

Presumptive Evidence.

Rights, Remedies, and Practice, 8 vols.

Usages and Customs.

Loeb, Isidor, LL. B. (University of Missouri, 1903.)

Married Women.

Mack, William, LL. B. (University of Missouri, 1887.)

Digest of Railway Law, 8 vols.

Digest American State Reports.

Martin, Alex., LL. D. (Dean Law Department, University of Missouri, 1889-1902.)
Civil Procedure.
Equity Cases.

Martin, William A. (University of Missouri, 1890.)
Articles (Cyclopedia of Law and Procedure).
Articles (Encyclopedia of Pleading and Practice), 3 vols.

McGruder, Mark A., LL. B. (University of Missouri, 1901.)
Laws of Commerce.

Thompson, Seymour D., LL. D. (Professor of Law, University of Missouri, 1880-1889.)
Carriers of Passengers.
Charging the Jury.
Electricity.
Juries.
Negligence, 2 vols.
Officers of Corporations.
Stockholders of Corporations.
Trials, 2 vols.

Tiedeman, Christopher G., LL. D. (Professor of Law, University of Missouri, 1881-1891.)
Commercial Paper.
Police Power.
Real Property.
Sales.
Unwritten Constitution, The.

Wilson, W. F., LL. B. (University of Missouri, 1900.)
Statutes of Oklahoma, 2 vols.
Oklahoma Digest.

Prize Theses. 1893-1902. Published in Central Law Journal.

1893. Loeb, Isidor—38 Cent. L. J. 4. LL. B., 1893.

"The Doctrine of Election in Equity."

1894. Tidd, A. L.—40—86. LL. B., 1894. "What Interference in the Performance of Contracts by Persons not Parties thereto is Actionable."

1895. Adams, D. E.—48—51. LL. B., 1895. "Possession, Actual or Constructive, in Law and Equity."

1896. Eppes, Thos. J.—45—148. LL. B., 1896. "Rights to Land Made by or Resulting from Accretion, Reliction and Evulsion."

1897. Gwinn, Arthur—57—464. LL. B., 1897. "Ratification in the Law of Agency."

1898. Thompson, G. A.—47—148. LL. B., 1898. "Right of Privacy as Protected and Recognized in Law and Equity."

1899. English, G. H.—51—360. LL. B., 1899. "The Law of Missouri Relating to Surface Water."

1900. Creason, Goodwin—54—42. LL. B., 1900. "The Law of Subrogation and the Modes of Enforcing it."

1901. Brown, N. S.—54—382. LL. B., 1901. Valedictorian, 1901. "Spendthrift Trusts."

1902. Chaney, W. L.—57—283. LL. B., 1902. "Liabilities of Parties to Joint and Several Contracts."

UNIVERSITY LIBRARY.

University Exhibit, Palace of Education.

Librarian J. T. Gerould.

The exhibit of the University Library consists of an album containing a few views of the interior, blanks covering the administrative work and a

few tables showing the growth and progress of the Library.

MATHEMATICS.

University Exhibit, Palace of Education.

Prof. E. R. Hedrick.

Some of the models exhibited were made at the University of Missouri. Others are a loan exhibit from Martin Schilling, of Halle, Germany. All are labelled but a brief description is here given of those made by students.

1. **Unilateral Closed Surface.**—This surface is an analysis situs model of a closed surface with only one side. It necessarily pierces itself. The red line is the path from a point to the point directly opposite. It does not divide the surface. The black line is a closed cut which divides the surface. The two cuts together divide the surface into a rectangular sheet (topographically). (Mr. Haines.)

2. **Klein's Icosahedron.**—A model of the icosahedron group of sixty operations, with its subgroups. All the regular solids are represented in colors, and the corresponding groups may be traced. The symbols for the operations of the group which carry the fundamental region one into the other fundamental regions are given by the cards attached to the model over the corresponding regions. (Miss Walker.)

3. **Surface of Constant Negative Curvature of the Hyperbolic Type.**—This particular model is the hyperbolic type of surface of rotation of con-

stant negative curvature. The blue lines are the geodetics, the green are the lines of constant geodetic distance (geodetic circles), the red are the lines of curvature, and the black are the asymptotic lines. (Mr. Ziegel.)

4. **Mold for Paper of Constant Negative Curvature.**—This mould was taken from Model No. 14, and corresponds to a=5 in the usual formula. (Curvature—a^2, in inches.) Paper moulded may be united into sheets for demonstration of new surfaces of constant negative curvature, or for demonstrating the applicability of these surfaces. (See No. 3.) (Mr. Zeigel.)

5. **Catenoid.**—This is the only Minimum Surface revolution. The red and the blue lines represent the lines of curvature, and the yellow lines the asymptotic lines. The asymptotic lines stand at right angles, since the radii of curvature are negative reciprocals by definition. (Miss Rabourn.)

6. **Anchor Ring With Group Figure of Deficiency One.**—The division of the surface into these parts determines (non-euclidean) motions of the ring into itself, which, together, necessarily form a group. The operations here represented are marked on corresponding fundamental regions. (Miss Walker.)

7. **Catenoid.**—Plaster model to illustrate Bonnet Property. (Miss Rabourn.)

8. **Double Ring Surface.**—Group of a deficiency two. (Miss Walker.)

9. **Meusnier's Theorem.**—"The radius of survature of an oblique section of any surface is equal

to the radius of curvature of the tangent normal section, multiplied by the cosine of the angle of inclination." The oblique section, the tangent normal section, and the surface itself, are shown in colors. The radius of curvature of the oblique section is shown as the projection of that of the normal section. (Mr. Bowman.)

10. **Helicoid. Minimum Screw Surface.**—The Helicoid is the only ruled minimum surface whose generating lines are parallel to a fixed plane. In this model, the asymptotic lines are shown in red and blue, and are orthogonal. The lines of curvature are yellow. (Miss Rabourn.)

11. **Pseudosphere.**—This model corresponds to a=5 in the usual formula. (Mr. Ziegel.)

12. **Mold for Constant Negative Curvature Paper,** a=10. (Mr. Ziegel.)

13. **Pseudosphere.**—This is a model for class demonstration. It corresponds to a choice of a=10 in the usual formula. The blue lines are geodetics, and the blue figure represents the failure of the Euclidean axiom of parallels on this surface (see No. 3). The red lines are the lines of curvature—the meridians and the circles of revolution—it is fairly apparent to the eye that the surface is of constant negative curvature from an inspection of these lines. The black lines are the asymptotic lines, whose torsion is shown to be a constant. Since the surface is of revolution, any line drawn may be revolved about the axis of revolution without altering its properties. (Mr. Ziegel.)

14. **Schwarz Cylinder. Fallacy of the Serret Definition of Area on a Surface.**—The inscribed triangles shown are supposed to increase in num-

ber indefinitely, while their dimensions all approach zero. Serret's definition of the area of a surface would make the area of the cylinder equal to the limit of the sum of the areas of the triangles. Schwarz showed that the limit of this sum depended upon the relative rates at which the two dimensions of the triangles approach zero. If (as represented) the width approaches zero more slowly than the height (as the inverse square) the limit will evidently exceed the area of the cylinder. (Mr. Shellenberger.)

15. **Surface of Constant Negative Curvature of the Cone Type.**—See Nos. 3 and 16. This is the third type of rotation surface of constant negative curvature. The vertex of this model may be thought to have ascended to infinity in the type of No. 16. The blue lines are geodetics; the red are lines of curvature; and the black are asymptotic lines. (Mr. Ziegel.)

16. **Real Representation of Imaginary Points of a Locus in Two Dimensions.**—The model represents all (real and imaginary) points of a real circle (blue), and those of two real straight lines (red). The intersections are all shown, those of one of the lines with the circle being imaginary. Real points are marked in white. (Mr. Ingold.)

17. **Mobius Band.**—This is an unilateral surface, which was first studied by Mobius. A closed curve does not necessarily cut the surface in two, and one can pass from any position to any other (counting both directions of the normal) without crossing the edge. (Mr. Monroe.)

18. **Unilateral Surface With Three Closed Cuts.** The model illustrates the theory of connectivity of surfaces. (Mr. Monroe.)

19. **Templets for the Models Nos. 3, 14, 16, 18.** These templets were used in marking the corresponding models, and illustrate the method of construction. (Mr. Ziegel.)

MECHANIC ARTS.

University Exhibit, Palace of Education.

Mr. W. H. Cook.

In a glass case are shown:

1. Specimens of class work in wood, iron and steel, and pattern making.
2. Specimens of work in mat and basket weaving, and in clay modeling by students of the Department of Education preparing to teach these subjects in the public schools.

Photographs illustrating work in this department are to be found in the album of University views.

MECHANICAL DRAWING.

University Exhibit, Palace of Education.

Mr. W. B. Rollins.

The exhibit from this department is intended to give a general view of the work as taught in the Freshman and Sophomore years of the Engineering courses.

During the Freshman year the student has some elementary mechanical drawing together with Descriptive Geometry drawing. The Sophomore

year is devoted to elementary work in Stereotomy, machine drawing and design, and water-color work, including topography.

On account of lack of exhibit space, only a few plates of each set are shown. All plates exhibited were made by students in actual class work.

MECHANICAL ENGINEERING.

University Exhibit, Palace of Education.

Prof. A. M. Greene.

Apparatus.—The apparatus for determining the stroke of pumps with a variable length of stroke, is to be attached to a pump to count the excess movement beyond a given length or the entire movement of the plunger. It is so arranged that each revolution recorded on the counter means one foot of movement.

The Anemometer Tester is to be used for determining the error in anemometers. It is to be mounted on a wall and can be run at various uniform speeds. By an electrical attachment the counting apparatus and the handle of the Anemometer will be thrown in operation at the same time, thus counting the revolutions of the arm when the anemometer is in full motion.

Test of Materials.—These materials are shown on three shelves. The second shelf represents the results of the investigation of Professor Marx and Schweitzer on the coals of Missouri, the relative amounts of ash, fixed carbon, volatile matter, sulphur and moisture being represented by the heights in the test tubes of the various substances

used to represent constituents. The coals are arranged in order of their heating values and the label on each tube gives the county from which the coal was taken and also the heating value of the coal. At one end of the line of tubes is a tube representing one of the eastern bituminous coals (Pocahontas) for reference. A bulletin giving the results of this investigation may be had in the fall, by application to the Engineering Department of the University of Missouri.

On the top shelf is placed a series of samples of lubricating oils which have been tested at the University. The results of these tests are given on the bottles.

On the third shelf the tests of belts, transmission ropes and steels are so labelled that the results of these are easily seen. It is to be noted that the tests of steel show the effects of nickel and also the difference in annealed and unannealed steels. The effect of splicing leather belts is shown in the test of belts. The tests on ropes were not very satisfactory, owing to the difficulty in gripping the specimen.

Drawing.—The drawings shown in the wing frames illustrate work in the courses on "Plants and Processes," "Machine Design" and "Boiler Design." In the course the drawings show several designs for a power house for the University and one elevation for one of the plans. These designs were worked out by the students to fit certain conditions. The "Machine Design" drawings represent details of the parts of a traveling crane, and the "Boiler Design" plates show the design of several types of boilers.

Chart.—The chart showing the subjects taught in the course in Mechanical Engineering gives the actual hours given to each subject. The drawings of the Mechanical Laboratory and of the Power House give some idea of the arrangement of the plant at Columbia.

Theses.—The theses of the department for the last year are in a case with the publications of the University, and may be seen on application to the attendant. The Reports of the students on Laboratory Work, a set of notes in Steam Engine Design, and the sketch work in Steam Engineering are also bound in book form.

Photographs are shown in an album and also in the end of the case.

SCHOOL OF MINES.

University Exhibit, Palace of Education.

Dr. George E. Ladd, Director.

A bird's-eye view in water-colors shows the buildings and grounds of the School of Mines as they appear in 1904.

Seven framed photographs on the wall help to make the picture more complete. These are again supplemented by an album of photographs.

Among the charts is one showing the growth of this department of the University.

Missouri Exhibit, Palace of Mines and Metallurgy.

Here is naturally located the chief exhibit of this department.

Laboratory.—In a section of a Chemical Laboratory for quantitative, qualitative, electrolytic

and assaying work all these processes are carried on in the exhibit.

Concentrator.—A model of a zinc and lead concentrating mill which begins with the rough ore and goes through all the processes is shown complete and in operation.

A Magnetic Separator shows the actual processes of separating iron pyrites from lead and zinc ores.

A Diamond Screw and Rock Section Machine prepares sections for petrographic work.

There is also an exhibit of Shop Work by the Freshman class and a display of chemically pure salts made by students.

Many of the specimens of Missouri minerals and ores in the exhibit are from the School of Mines.

There is further an exhibit of road-making materials and model sections of roads showing their use.

Photographs.—Besides several large framed photographs of the buildings and grounds of the school there is shown in an album a large number of other views.

Among pieces of apparatus from the School special mention should be made of a Zeiss Microscopic Electrical Projection apparatus and Optical Bank and a Stromberg-Carlson Mine Telephone.

Missouri Exhibit in the Mining Gulch.

Here is in operation a pneumatic mine pump, invented at the School of Mines. It is of interest to know that this pump was adopted by the City of New York to pump out the Croton aqueduct.

Exhibit of Agricultural Colleges and Experiment Station, Palace of Education.

Here are thirty transparencies showing scenes in and about the School of Mines.

POLITICAL SCIENCE AND PUBLIC LAW.

University Exhibit, Palace of Education.

Prof. Isidor Loeb.

County Organization in Missouri.—This department exhibits a series of fourteen maps illustrating the development of Missouri by indicating the important periods in the growth of county organization in the State. The first five maps deal with the period before the admission of Missouri into the Union, during which time it was known successively as the District and Territory of Louisiana and the Territory of Missouri, and included the territory embraced within the present State of Arkansas.

The first map (1804) shows the five original districts whose western boundaries were defined in 1812. Washington and Arkansas counties were organized in 1813 and Lawrence and Howard in 1815 and 1816 respectively. During 1818, the effects of the settlements along the valleys of the Mississippi and Missouri were evidenced by the creation of eight new counties in Missouri proper. During 1820, under the State government which was inaugurated before the State was formally admitted into the Union, the movement continued and by January 1, 1821, the total number of organized counties was twenty-five.

Only a few counties were organized during the next decade, but with 1832, the most active period of county building begins, and by March 1, 1841, the number of organized counties amounted to seventy-seven, which number was further increased by March 31, 1845, to ninety-six, with one unorganized district. Each succeeding General Assembly, with one exception, organize, one or more counties until by 1860 the total amounted to 113. In 1861, the unorganized district which had been attached to Gentry county was organized as Worth county. Finally, in 1876, the City of St. Louis was given a separate organization, thus completing the development with 114 counties and one city possessing the functions of a county.

PHYSICS.

University Exhibit, Palace of Education.

Prof. O. M. Stewart.

The exhibit of this Department consists in photographs and drawings mounted in wing frames and in a volume of laboratory reports.

Of the wing frames the first contains floor plans of such portions of the Engineering building as are devoted to Physics. The second contains photographs illustrating special experiments and pieces of apparatus. The third frame is devoted to diffraction phenomena in light. It contains a number of photographs showing the diffraction patterns due to various objects and a drawing showing the arrangement of apparatus by which the photographs were made. The fourth and last frame

shows a number of pieces or groups of apparatus for use in the laboratory, and photographs and a drawing illustrating experiments in the interferference of light. The latter group consists in a photograph of a Michelson interferometer, constructed by the University mechanician and mounted on a Gaertner comparator. A drawing showing the path of light in the instrument, and photographs of the interference fringes formed under various conditions.

In the bound volume of reports are some of experiments performed by students in the elementary laboratory and some of experiments performed by the more advanced class in electrical measurements.

PHYSIOLOGY AND PHARMACOLOGY.

University Exhibit, Palace of Education.

Professor C. W. Greene.

The exhibit is in two parts:

A. A portion of the apparatus used and a series of records of experiments on the effect on the animal organism of certain anaesthetics and inorganic salts.

B. A collection of pharmacological preparations in bottles.

PHYSICAL TRAINING.

University Exhibit, Palace of Education.

Professor C. W. Hetherington.

A bound volume contains a record complete, so far as is possible, of every man who has played on

the football teams, the baseball nines and track teams of the University.

An album is shown containing views of the University quarters for Physical Training, gymnasium, tennis courts, athletic fields, golf links, and of students.

A framed picture shows the front and side elevations of the proposed gymnasium.

Department of Physical Culture, Physical Culture Building.

Maps and plans are shown of the University grounds, showing the location and character of the Athletic fields and golf links. Framed pictures show both the elevations and the floor plans of the new gymnasium. An album of photographs illustrates the work in Physical training in the University.

EXPERIMENTAL PSYCHOLOGY.

University Exhibit, Palace of Education.

Prof. Max Meyer.

Reed Organ.—This organ is intended merely for use in the Psychological Laboratory, not for concert use. Its tuning is entirely unique. By means of different stops one may play either in tempered or in just intonation. See directions printed on the organ. The arrangement of the tones in just intonation differ considerably from the arrangement found in other organs tuned in just intonation. For a fuller understanding of the theoretical principles involved the reader is referred to the following literature:

Contributions to a Psychological Theory of Music. The University of Missouri Studies 1 (1), 1901.

Some Points of Difference Concerning the Theory of Music. Psychological Review 10, 1903.

Zur Theorie Japanischer Musik. Zeitschrift fur Psychologie 33, 1903.

Experimental Studies in the Psychology of Music. American Journal of Psychology 14 (Commemorative Number), 1903.

Some of the different lines of work for which the organ is used may be mentioned briefly:

The organ is an excellent apparatus for introducing the student in an elementary laboratory course into the natural laws of the subjective difference tones. One class of experimental work of this sort, familiar to the students who study Psychology in the Psychological Laboratory of the University of Missouri, is the following: The student is told what the vibration rate of one of the tones is, e. g., the tone f. He then has to determine the vibration rates of all the other tones by means of no other aid but his own ear. He sounds one of the f's together with any other tone until he finds that the lowest difference tone audible is one of the given f's. He then finds by a simple calculation the vibration frequency of a new tone. In this way he proceeds until he has determined all the tones. By means of this application of the theory of difference tones to a practical problem the student learns to pay attention to delicate auditory phenomena in general.

The organ may also be used in the investigation of the theoretical principles on which, from a psychological point of view, quartertone music

must be regarded as being based. By "quarter-tone music" is meant music which can not be played on our common musical instruments because it requires tones lying between the tones of our common scale of twelve notes. (The smallest interval of our common scale is called semitone; smaller intervals may therefore conveniently be called quartertones.) The greater part of Japanese music seems to be of this character. Such music can be played on this organ in just intonation and its aesthetic effects may thus be studied in detail.

Hearing-Model (Psychological Laboratory.)—This apparatus is to illustrate the process of hearing. It consists of three parts: 1. A movable curve, representing the alternately increasing and decreasing pressure of the air which acts upon the tympanum when we hear. 2. An analyzing machine, representing the cochlea, which dissolves the just mentioned physical process—if complex—into a number of simpler partial processes by mechanical means in a manner similar to the hydrodynamical function of the cochlea. 3. A system of lamps, representing the brain, which receive from the analyzer the resulting partial processes as intermittent electrical currents of different frequencies.

Follow these directions: Move the whole curve —from one end to the other—through the apparatus by turning the small crank. Observe that some of the lamps glow up a greater, while others a smaller number of times, corresponding to the different tones which we hear simultaneously in such a case. The whole process may be repeated,

of course, any number of times, as we hear chords for longer or shorter times.

The curve in the apparatus represents the objective (physical) tones 8 and 5; the subjective (heard) tones are then usually 8, 5, 3, 2, and 1. The apparatus illustrates thus the two most important functions of our organ of hearing: 1. The analysis of compound sound. 2. The production of the subjective difference tones.

Do not leave the apparatus without moving the curve entirely to either side! This position is indicated by all the lamps ceasing to glow.

ROMANCE LANGUAGES.

University Exhibit, Palace of Education.

Prof. Raymond Weeks.

Phonetic Tracings.—Framed and hung on the wall of the exhibit space is a selection of tracings showing some of the work done in this department in the study of Philology by means of permanent records of spoken language.

Talking Machine.—On the table is placed a Victor talking machine with a supply of plates for graded lessons in Spanish and French, to indicate the method used in the University to teach the pronunciation of these languages.

Photographs.—In the album of University views are photographs showing the Romance Department library and students using the talking machine.

SOCIOLOGY.

University Exhibit, Palace of Education.

Professor C. A. Ellwood.

A. A series of five Demographical Maps of Missouri:

1. Map illustrating the distribution of the foreign born population of Missouri by counties (1900).
2. Map illustrating the distribution of the German born element of Missouri by counties (1900).
3. Map illustrating the distribution of the negro population of Missouri by counties (1900).
4. Map illustrating the distribution of the excess of males in the population of Missouri by counties (1900).
5. Map illustrating the distribution of illiteracy in Missouri by counties (1900).

B. A series of three maps illustrating almshouse conditions in Missouri (from data collected by the Department of Sociology, 1903).

1. Map showing the number of counties caring for their paupers by the lease system, and the number of counties paying their almshouse officials fixed salaries.
2. Maps showing the counties having insane persons in their almshouses.
3. Map showing the cost of county almshouses in Missouri.

C. Sociological Map of Columbia, Missouri, showing (1) distribution of population by color; (2) by amount of taxable property; (3) location of various social, economic, political, educational, and religious institutions of the city.

D. A Study of the Negroes of Columbia, Missouri (Master's Dissertation), by William Wilson Elwang. Principal topics treated, economic conditions, occupations and wages, fraternal societies, housing conditions, health and morals, education, religious life, crime, and political condition of the negro population of Columbia, Missouri.

E. A Bulletin on the Condition of the Almshouses of Missouri by Charles A. Ellwood.

F. A Bulletin on the Condition of the County Jails of Missouri by Charles A. Ellwood.

G. Other Publications of Members of the Department.

UNIVERSITY PUBLICATIONS.

University Exhibit, Palace of Education.

The Law Department is represented by a nearly complete set of the publications of those who have been connected with this department as teachers or students. A partial list of the publications of the members of the present Faculty is in the same care. A fairly complete list of the official publications of the University, including a complete file of the University catalogue is also shown.

VETERINARY SCIENCE.

University Exhibit, Palace of Education.

Prof. J. W. Connaway.

There are shown.

1. Diseases of cattle and the method of cure, particularly the cure of milk fever by pumping sterilized air into the udder.

2. The cause and cure of Texas Fever. Models of cattle show the native Texas steer, blooded cattle sickening and dying of this disease before discovery of the means of cure, and blooded cattle which, after inoculation by Dr. Connaway's method may now be safely sent to Texas.

3. Diseases of horses and their cure.

4. Diseases of swine and their cure.

5. An album of photographs illustrative of the work at the University in Veterinary Science.

ZOOLOGY.

University Exhibit, Palace of Education.

Prof. George Lefevre.

The exhibit of the Zoological Laboratory is, in the main, of educational interest, and illustrates to a certain degree, the character and extent of the work of instruction carried on in the department.

The exhibit may be classified under three heads:

1. **General Exhibit.**—This is contained in a case which forms a part of the general exhibit of the University displayed in the Educational Building.

1. An unusually beautiful collection of marine invertebrates from the Atlantic coast is here shown, representing all the groups of invertebrates from the Sponges and Coelenterata, including such interesting forms as sea-anemones, hydroids and corals, to the Tunicata which stand on the border-line between the Invertebrates and Vertebrates. Many of these organisms represent material used in courses of instruction concerned with the study of Comparative Invertebrate Zo-

ology. Particular attention is directed to the dissected specimens showing anatomical structure; for example, the dissection of the nervous system of the common Blue-crab. Most of these dissections have been made by students of the Laboratory.

2. The exhibit of Vertebrates is chiefly of an anatomical and embryological nature, and many dissections and preparations are displayed which are of interest from the point of view of Comparative Anatomy and Embryology. The material is largely taken from courses of instruction in these subjects.

3. A sample equipment is shown of microscope, microscopical supplies, and small instruments furnished the individual student in courses of instruction given in the Laboratory.

4. A new method of embedding small objects in paraffine by the use of a special form of watch-glass is demonstrated.

5. In the same case are contained certain collections from the Missouri fauna; namely, Reptiles, Batrachians, Crayfish, and Fresh-water Mussels, but these will be referred to under Exhibit C.

6. Publications embodying the results of original work carried on in the Zoological Laboratory.

II. Drawings and Photographs.—A collection of drawings and photographs is to be found with the general exhibit.

1. The photographs show the main working rooms of the Laboratory, as well as certain important pieces of apparatus belonging to the equipment of the Department of Zoology; for example, the microscopic projection apparatus and one of the cases of embryological models.

A series of photographs taken in the Zoological Museum is also presented.

2. The collection of students' drawings is the most important phase of the entire exhibit from an educational point of view. A series of typical drawings made by students is shown for each course of instruction given in the department that involves practical laboratory work. These drawings not only illustrate the character of work done by students, but also indicate the extent of the field covered in the several Zoological courses.

Missouri Fish and Game Exhibit, Palace of Forestry, Fish, and Game.

III. Collection from the Missouri Fauna.—This exhibit comprises collections of Missouri Mammals, Birds, Fishes, Reptiles, Batrachians, and Invertebrates. The last three groups are displayed with the general exhibit, as already stated.

The Mammals, Birds, and Fishes are exhibited separately under the Department of Fish and Game of the Missouri Commission, and are to be found in the Building for Fish, Game, and Forestry. Only such forms as are of interest to the sportsman as game animals or enemies of game are contained in these collections. Attention is especially directed to the Ducks, Hawks, and Owls.

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